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LISTS OF SPECIES

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Angiosperm diversity of the Great Indian Bustard Wildlife Sanctuary: a semi-arid grassland, Maharashtra, India

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Abstract: The Great Indian Bustard Wildlife sanctuary is a semi-arid grassland ecosystem spread over an area of 1,222 km² in the Solapur and Ahmednagar districts of Maharashtra, India. It is an abode of the critically endangered bird, the Great Indian Bustard. A total of 436 plants belonging to 259 genera and 67 families are reported in the present study from the sanctuary, including 22 endemic taxa. Grasses form one of the dominant components of the ecosystem and are represented by about 67 species. The sanctuary is facing severe habitat loss and degradation, posing a threat to its biodiversity. This paper provides a comprehensive documentation of the floristic diversity of the sanctuary. Threats and conservation measures are also discussed.

Key words: inventory, floristics, Nannaj, protected area, Solapur.

INTRODUCTION

Grasslands are a major component of the world's vegetation, covering about 24% (Shantz 1954). They are considered to be a major potential sink for carbon, as grassland soil stores more carbon compared to forest soil (Dinakaran et al. 2011). Grasslands occur in places where temperature, precipitation and physical factors such as soil and drainage combine to create conditions that are too dry for trees to grow. Grasslands have evolved through grazing, drought and periodic fire, and therefore almost all grasslands are maintained by either one or a combination of these factors. They provide habitats for many different animals, birds, insects and lizards, which depend on each other for survival (Allaby 2006; Nancy et al. 2013).

Despite their widespread occurrence, grasslands are shrinking at an alarming rate globally, and are fast becoming one of the most endangered of ecosystems (IUCN 2014). The rapid decline of natural grasslands is due to several reasons. Traditionally, grasslands and scrub have been considered as "wasteland". They are prime targets for development projects. About 16% of tropical grasslands have been converted for agriculture or urban development. In forming relatively open areas with low-stature vegetation which intercepts high light intensity, grasslands are also vulnerable to invasive species (Wagner 1989). Their structure and function make them one of the most vulnerable of terrestrial ecosystems to global climate change (Schlesinger 1997; Mooney and Hobbs 2000; Lejeune and Seastedt 2001). Grassland studies are therefore of paramount importance and a pre-requisite for conservation and management of wildlife (Rodgers and Sawarkar 1988; Rahmani 1992).

India has an estimated coverage of grasslands and shrub lands that vary from 3.7 percent to as much as 12 percent of the total area (UNDP 2012). Whyte (1957) has classified Indian grasslands into eight types while Champion and Seth (1968) recognized only three broad categories. The Indian Council of Agricultural Research (ICAR) classified them into five categories, namely *Sehima–Dichanthium* type, *Dichanthium–Cenchrus-Lasiurus* type, *Phragmites–Saccharum–Imperata* type, *Themeda–Arundinella* type and temperate and alpine cover, based on the dominant grass composition (Dabadghao and Shankarnarayan 1973). Based on eco-climatic factors, the Indian grasslands fall under four categories: Himalayan pastures, Terai grasslands, semi-arid grasslands and Shola grasslands. Among these, semi-arid grasslands are found in Western India, Central India and Deccan and are characterized by grassland tracts with patches of thorn forests.

The Bustard Sanctuary comes under the semi-arid grasslands category and is the abode of the Critically Endangered species the Great Indian Bustard [*Ardeotis nigriceps* (Vigors, 1831)] (Birdlife International 2011). This ostrich-like bird occurs in the semi-arid grasslands and deserts of India. It prefers open landscapes, and in particular grassy plains in arid and semi-arid areas interspersed with scrub and low bushes (Rahmani 2006;

Munjpara et al. 2012). It is locally known as "*Maldhok*" in Marathi. Floristic studies in the semi-arid part of Deccan are few when compared to the Western Ghats region of Maharashtra. However, some publications have described areas adjacent to the Bustard Sanctuary (Naik 1979; Pradhan and Singh 1999; Suryavanshi and Bachulkar 2011; Das Das and Singh 2011; Gaikwad et al. 2012; Das Das 2012). No floristic documentation of the Bustard Sanctuary is available to-date, and hence, this study was undertaken with the primary objective of the Botanical Survey of India to explore, inventory and document plant diversity in protected areas of India.

MATERIALS AND METHODS

Study area

The Great Indian Bustard Wildlife Sanctuary (GIB-WLS) was declared a sanctuary *vide* notification No. WLP-1078/72634/FI in 1979 by the Indian Board for Wildlife to protect the critically endangered and endemic bird, the Great Indian Bustard (GIB). It is located in Solapur and Ahmednagar district of Maharashtra and lies between 17°22′17″ to 18°54′42″ N and 074°23′34″ to 076°15′01″ E (Figure 1). The sanctuary is spread over an area of *ca.* 1,222 km². It also includes about 393 villages within its boundary. In general, the terrain of the sanctuary is flat and undulating with an average elevation of 500 to 600 m above mean sea level and covered by a thin mantle of black cotton soil. Apart from black soil, the soil colour varies from reddish brown to coarse grey. The study area comes under the forest types of semi-arid biotope, open scrublands and southern tropical thorn forest (Champion and Seth 1968). The common tree species in this ecosystem are: *Acacia nilotica, A. catechu, Capparis decidua, Senna auriculata, Mimosa hamata* and *Ziziphus mauritiana*. The common herbs include *Aeschynomene indica, Alysicarpus vaginalis, Biophytum sensitivum, Cleome viscosa, Glossocardia bosvallia, Indigofera cordifolia* and *Indigofera linifolia*. The common grasses are *Apluda mutica, Chrysopogon fulvus, Cymbopogon martini, Dichanthium annulatum, Heteropogon contortus, Ischaemum afrum* and *Setaria pumila*. Factors such as poor soil quality, frequent fire and erosion contribute to the lack of regeneration of the main species and deterioration of native vegetation. The area belongs to the rain shadow region and is prone to annual droughts. June to September is the southwest monsoon season. October and November constitute the post-monsoon or retreating monsoon season. The average annual rainfall in the district is between 550 mm to 650 mm. May is the hottest month with mean daily maximum temperature of 39.9°C and the mean daily minimum of 25.1°C. Grasses form one of the dominant components of the ecosystem. Agriculture is the main occupation of the people in this region. The main crops cultivated include rice, jowar, bajra, pulses, cotton, sugarcane, groundnut, sunflower, turmeric, onion and vegetables such as lady's finger, brinjal, gourds and spinach. Fruits such as grapes and bananas are also cultivated. Plants such as *Parkinsonia aculeata, Eucalyptus tereticornis, Acacia auriculiformis, Dodonaea viscosa, Albizia lebbeck, Casuarina equisetifolia, Duranta repens, Gliricidia sepium, Azadirachta indica,* etc., are planted near the forest guest houses and along the roadsides.

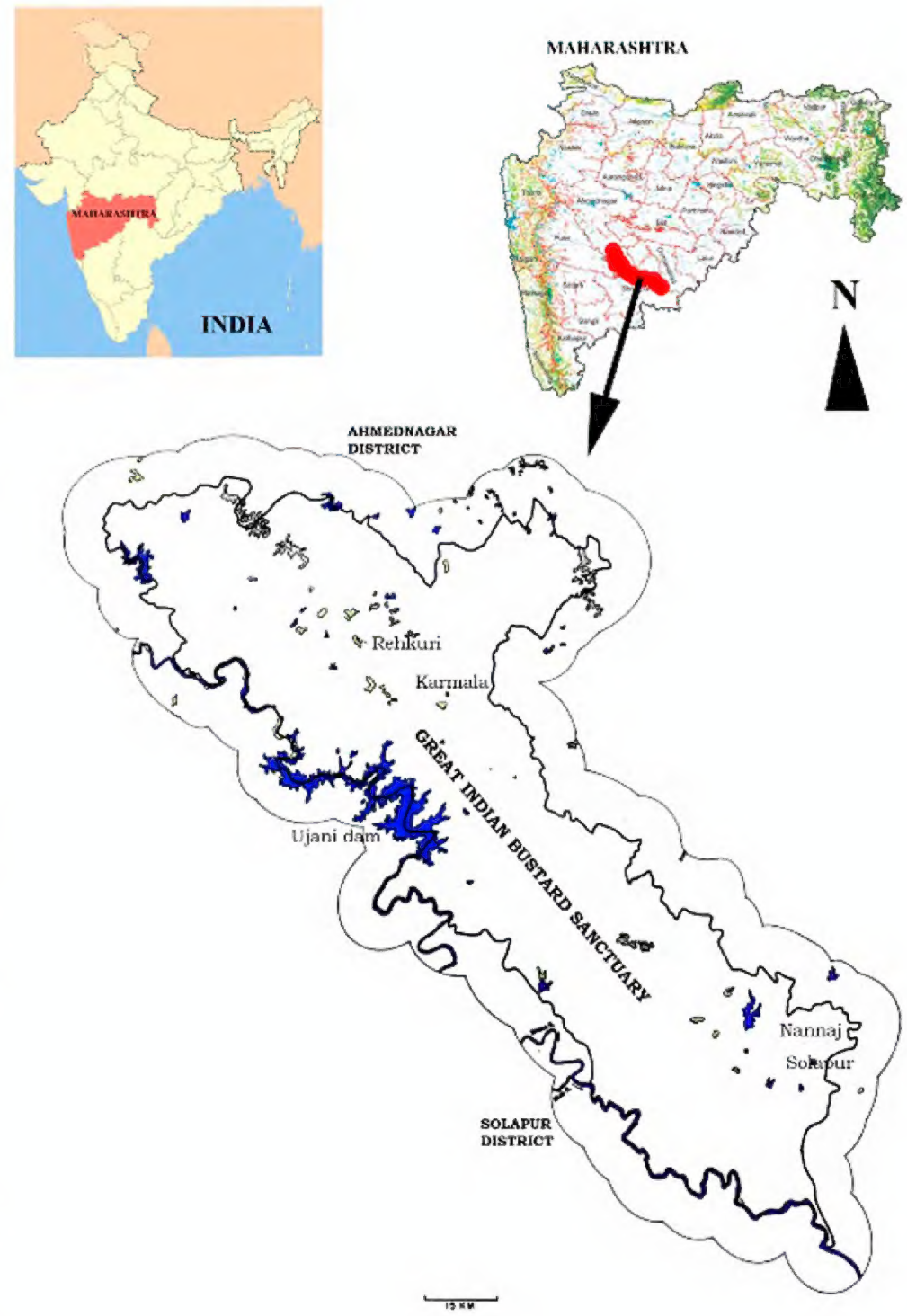

Figure 1. Map showing the study area.

Data collection

Regular plant exploration tours were undertaken from July 2010 to December 2012. Field trips were organized in different seasons and covered all parts of the study area. In each field trip, the data collected include: habit, habitat, flowering period and local names. Plant samples of all the species were collected from different areas of the sanctuary. The specimens were critically studied for morphological details and for correct identification. Identification was confirmed by consulting standard literature (Cooke 1901; 1908; Naik 1979; Sharma et al. 1996; Pradhan and Singh 1999; Singh and Karthikeyan 2000; Singh et al. 2001; Bhagat et al. 2008; Karthikeyan et al. 2009) and through reference against identified herbarium specimens at Botanical Survey of India, Western

Regional Centre herbarium, Pune (BSI) and Blatter herbarium, Mumbai (BLAT). Web databases such as The Plant List (2013), International Plant Names Index (IPNI 2013), Tropicos, Biodiversity Heritage Library (BHL 2013), Global Biodiversity Information Facility (GBIF 2013) and Kew World Checklist of Selected Plant Families (WCSP 2013) were also consulted for correct nomenclature, author citation and additional information. Author names have been standardised based on Brummitt and Powell (2004). The voucher specimens are deposited at BSI Herbarium Pune, Maharashtra.

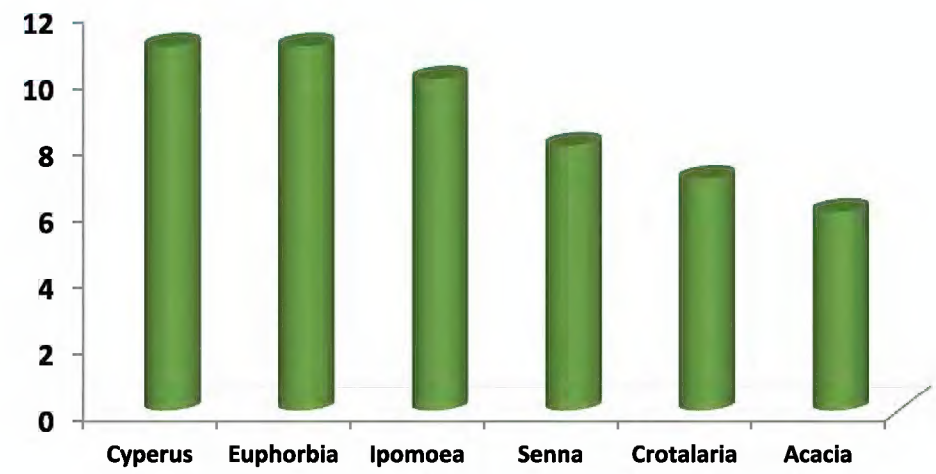

Figure 4. Dominant genera in GIBWLS.

RESULTS

Intensive study on the floristic diversity of the Great Indian Bustard Sanctuary resulted in documentation of a total of 436 taxa (Table 1). They belong to 259 genera spread over 67 families. Of these, 317 (73%) taxa belong to dicotyledons and 119 (27%) taxa to monocotyledons (Figure 2). The most dominant families are Poaceae (67 taxa), Fabaceae (41 taxa), Cyperaceae (30 taxa), Asteraceae (29 taxa) and Euphorbiaceae (24 taxa) (Figure 3). Genera such as *Cyperus, Euphorbia, Ipomoea, Senna, Acacia* and *Crotalaria* are dominant, possessing greatest species diversity (Figure 4). The flora of the sanctuary is categorized into different life-forms such as trees, shrubs, herbs and climbers in which herbs dominate the flora followed by shrubs and climbers (Figure 5). Trees are poorly represented with only 30 taxa, most of which belong to the genus *Acacia* which is characteristic of the semi-arid ecosystem. Twenty-two endemic taxa were also recorded during the present study: *Cleome simplicifolia, Crotalaria filipes, Crotalaria vestita, Vigna indica, Hardwickia binata, Dichrostachys cinerea* var. *indica, Neonotis montholoni, Glossocardia bosvallia, Tricholepis radicans, Exacum pumilum, Hemigraphis urens, Euphorbia notoptera, Aristida stocksii, Isachne borii, Iseilema anthephoroides, Lophopogon tridentatus, Oropetium roxburghianum, Oropetium villosulum, Sehima sulcatum, Spodiopogon rhizophorus, Tragus mongolorum* and *Tripogon jacquemontii.*

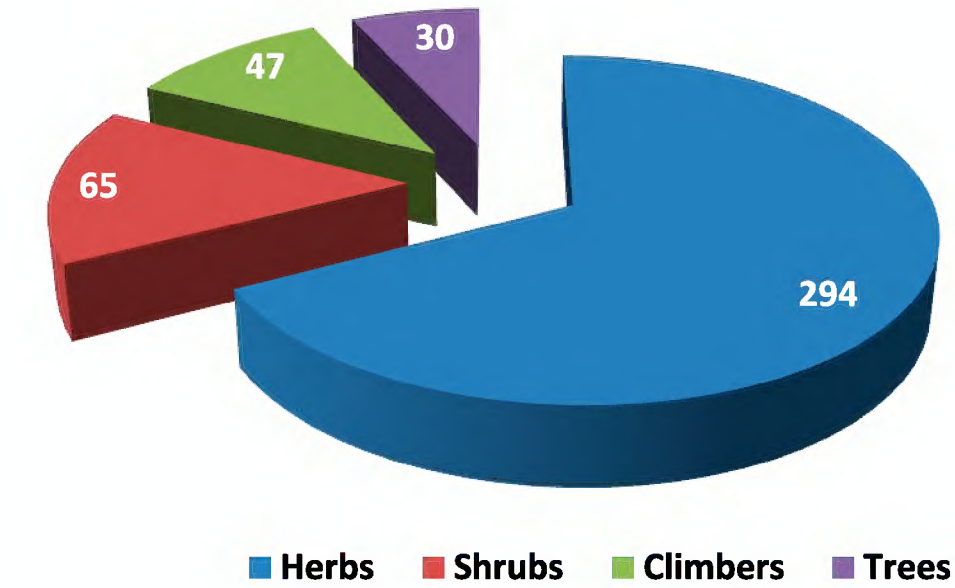

Figure 5. Distribution of life-forms in GIBWLS.

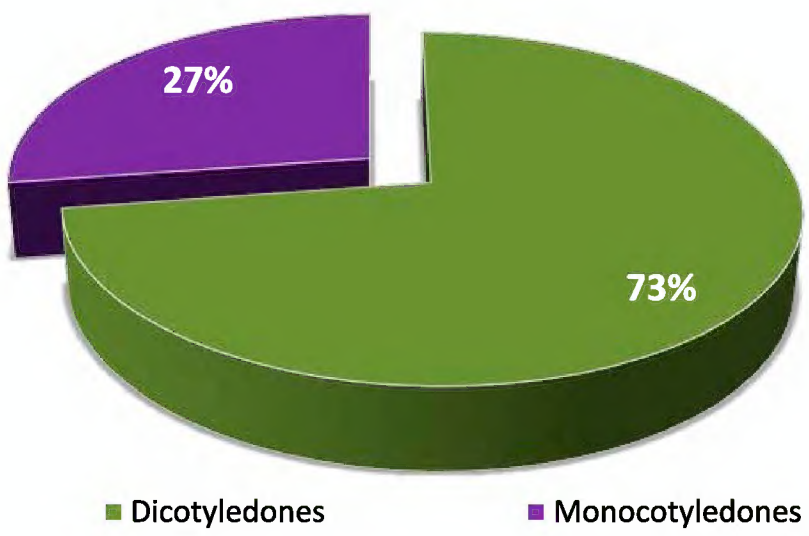

Figure 2. Distribution of dicots and monocots.

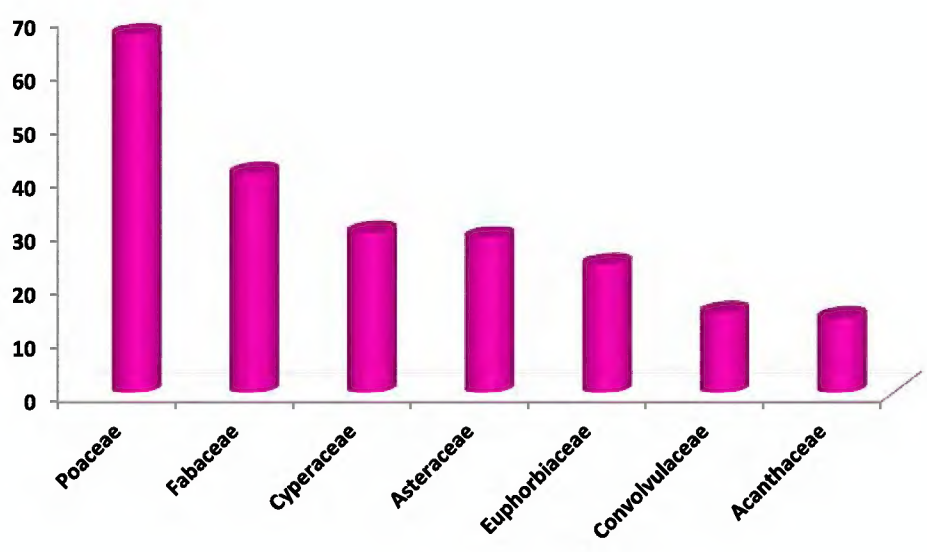

Figure 3. Dominant families of GIBWLS.

DISCUSSION

In India, less than one percent of grasslands come under the protected area network, of which 0.24% lies in the semi-arid zone. Some of the protected areas of arid and semi-arid grasslands serve as an important genetic resource in the form of grass and shrub species which are vital for maintaining ecological balance and for food security of the country. These protected areas therefore should not only be considered as key for wildlife conservation, but also as gene banks given that modern cereals have originated from wild grasses (Government of India 2006).

The GIBWLS, which is a grassland ecosystem that accounts for 67 wild grass species and 41 wild legumes, is facing rapid industrialization, conversion of grassland to farmlands and an increase in human population

during the last 30 years. There are also several micro-industries, stone and brick quarries and sugar cane factories located or emerging around the sanctuary's periphery. The cumulative impact of all these land-use pressures has lead to severe degradation of habitat, which in turn is leading to a decline in the population of Great Indian Bustard (Dutta et al. 2011). The remaining suitable habitat consists of small and scattered grassland patches protected under the Drought Prone Areas Programme plots, which was introduced by the Central Government. The total aggregate area of these scattered patches is not more than 400 km^2, with the biggest patch located in the village called Nannaj that lies to the north of Solapur town.

Plantations of trees such as *Gliricidia, Azadirachta, Eucalyptus* and *Acacia auriculiformis* in the grasslands will adversely affect the habitat's suitability for birds and animals and hence they should be removed. The spread of obnoxious invasive weeds such as *Hyptis suaveolens, Parthenium hysterophorus, Lantana camara* and *Cassia uniflora* should be controlled and they should be removed from the grassland. Prioritising conservation measures at potential areas such as Nannaj, Mardi, Akolekati, Karamba, Gangevadi, Chapadgaon, Rehkuri and Korti is essential, as these areas harbour several endemic species as well as forming habitat for *Ceropegia bulbosa*; a relatively rare species in the sanctuary.

A total of 22 peninsular endemic species were collected and recorded from these areas during this study. It is observed that 24 grass species have potential fodder value: *Apluda mutica, Bothriochloa pertusa, Cenchrus setigerus, Chloris gayana, Cynodon dactylon, Dactyloctenium aegyptiacum, Dichanthium foveolatum, Digitaria ternata, Echinochloa colonum, Eleusine indica, Eragrostis pilosa, Eragrostis tenella, Eragrostis viscosa, Heteropogon contortus, Melanocenchris jacquemontii, Oryza sativa, Panicum hippothrix, Panicum curviflorum, Paspalidium flavidum, Pennisetum pedicellatum, Pennisetum purpureum, Sehima ischaemoides, Sporobolus indicus* and *Tetrapogon tenellus.* These grasses may be promoted in the sanctuary. Flowers of species such as *Indigofera linifolia, Alysicarpus* spp., *Cyanotis fasciculata* and *Chlorophytum tuberosum,* etc. are the main attraction for many beetles and insects. During the study, it was also observed that species such as *Apluda mutica, Aristida redacta, A. stocksii, Echinochloa colona, Iseilema anthephoroides, Lophopogon tridentatus, Melanocenchris jacquemontii, Oropetium spp., Ledebouria hyacinthina, Chlorophytum tuberosum, Boerhavia diffusa, Boerhavia erecta, Vigna indica, Lepidagathis cristata, Spermacoce pusilla, Trichodesma indicum, Cyanotis fasciculata, Ipomoea eriocarpa, Indigofera cordifolia, Lavandula bipinnata,* etc. support a variety of insects, beetles, and grasshoppers which are the main diet of many grassland birds and animals. Care must be provided to help increase the population of these plant species.

Furthermore, GIS studies should be undertaken for mapping the area to identify the potential grassland patches and level of disturbances in the landscape so as to plan for suitable habitat restoration programmes. Considering this scenario of habitat loss and degradation,

Table 1. List of species in the study area (abbreviations: H= herbs, S= shrubs, C= climbers, T= trees, *= species added based on literature as well as observation in field in vegetative condition.

Taxa	Habit	Flowers	Field No.
Acanthaceae			
Andrographis echioides (L.) Nees	H	August – September	JJ 198125
Barleria prionitis L.	S	November – December	JJ 199362
Dicliptera paniculata (Forssk.) I. Darbysh.	H	October – December	JJ 199311
Dicliptera verticillata (Forssk.) C.Chr.	H	November – December	JJ 199323
Hemigraphis urens (Roth) J.R.I. Wood	H	November – December	JJ 199389
Hygrophila schulli (Buch.-Ham.) M.R.Almeida & S.M.Almeida	H	November – December	JJ 199361
Justicia diffusa Willd.	H	August – May	*
Justicia japonica Thunb.	H	August – September	JJ 198002
Lepidagathis cristata Willd.	H	August – December	JJ 198158
Lepidagathis trinervis Nees	H	November – May	*
Ruellia patula Jacq.	H	July – August	JJ 199257
Ruellia prostrata Poir.	H	July – August	JJ 199405
Rungia elegans Dalzell & A. Gibson	H	November – December	JJ 199360
Rungia repens (L.) Nees	H	August – September	JJ 198148
Agavaceae			
Agave americana L.	H	October – December	JJ 199491
Aizoaceae			
Trianthema portulacastrum L.	H	September – October	JJ 198277
Amaranthaceae			
Achyranthes aspera L.	H	October – December	JJ 198052
Aerva javanica (Burm. f.) Juss.	H	October – December	JJ 199467
Alternanthera pungens Kunth	H	September – December	JJ 198222

Continued

Table 1. *Continued.*

Taxa	Habit	Flowers	Field No.
Alternanthera sessilis (L.) R. Br. ex DC.	H	August – December	JJ 198131
Alternanthera tenella Colla	H	August – December	JJ 198172
Amaranthus spinosus L.	H	July – December	JJ 199239
Amaranthus viridis L.	H	August – December	JJ 198270
Celosia argentea L.	H	July – October	JJ 198205
Digera muricata (L.) Mart.	H	August – October	JJ 198255
Gomphrena serrata L.	H	August – September	JJ 198054
Pupalia lappacea (L.) Juss.	H	August – September	JJ 198254
Anacardiaceae			
Rhus mysorensis G. Don	S	July – December	JJ 199288
Apiaceae			
Centella asiatica (L.) Urb.	H	September – October	JJ 199412
Apocynaceae			
Catharanthus pusillus (Murr.) G. Don	H	September – October	JJ 198193
Catharanthus roseus (L.) G. Don	S	September – December	JJ 199477
Araceae			
Colocasia esculenta (L.) Schott.	H	July – December	JJ 199490
Arecaceae			
Borassus flabellifer L.	T	March – June	*
Phoenix sylvestris (L.) Roxb.	T	March – June	*
Aristolochiaceae			
Aristolochia bracteolata Lam.	H	July – September	JJ 199254
Asclepiadaceae			
Asclepias curassavica L.	H	October – February	JJ 199471
Calotropis gigantea (L.) R. Br.	S	Almost throughout the year	JJ 199235
Calotropis procera (Aiton.) R. Br.	S	Almost throughout the year	JJ 198401
Caralluma adscendens (Roxb.) R. Br.	H	July – September	JJ 198063
Ceropegia bulbosa Roxb.	C	August – September	JJ 198119
Dregea volubilis (L.f.) Benth. ex Hook.f	C	August – October	JJ 198141
Marsdenia sylvestris (Retz.) P.I. Forst.	C	July – October	JJ 199258
Pentatropis capensis (L. f.) Bullock	C	July – October	JJ 199283
Pergularia daemia (Forssk.) Choiv.	C	August – September	JJ 198132
Secamone emetica (Retz.) R. Br.	C	July – August	JJ 199255
Tylophora indica (Burm. f.) Merr.	C	August – September	JJ 199478
Asteraceae			
Acanthospermum hispidum DC.	H	September – October	JJ 198179
Ageratum conyzoides L.	H	September – December	JJ 194802
Anaphalis subdecurrens (DC.) Gamble	H	September – December	JJ 198296
Bidens biternata (Lour.) Merr. & Sherff.	H	September – December	JJ 198098
Blainvillea acmella (L.) Philipson	H	September – December	JJ 198134
Blumea axillaris (Lam.) DC.	H	October – December	JJ 199320
Blumea lacera (Burm. f.) DC.	H	August – December	JJ 199315
Blumea oxyodonta DC.	H	October – December	JJ 199335
Caesulia axillaris Roxb.,	H	September – October	JJ 198062
Cyanthillium cinereum (L.) H. Rob.	H	September – October	JJ 198110
Cyathocline purpurea (Buch.-Ham. ex D. Don) O. Ktze.	H	October – December	JJ 199316
Dicoma tomentosa Cass.	H	October – December	JJ 198088
Echinops echinatus Roxb.	H	October – December	JJ 199327
Eclipta prostrata (L.) L.	H	August – October	JJ 198221
Emilia sonchifolia (L.) DC.	H	September - October	JJ 198109
Flaveria trinervia (Spreng.) C. Mohr.	H	July – August	JJ 199297
Glossocardia bosvallia (L. f.) DC.	H	September – October	JJ 198015
Goniocaulon indicum (Klein ex Willd.) Clarke	H	November – December	JJ 199388
Grangea maderaspatana (L.) Poir.	H	July – August	JJ 199223
Lagascea mollis Cav.	H	August – September	JJ 199215
Launaea procumbens (Roxb.) Ramayya & Rajagopal	H	August – September	JJ 199295
Parthenium hysterophorus L.	H	August – September	JJ 198212
Pluchea lanceolata (DC.) C.B. Clarke	S	October – December	JJ 199400
Pseudognaphalium luteo-album (L.) Hillard & B.L. Burtt.	H	September – December	JJ 199352
Pulicaria wightiana C. B. Clarke	H	August – September	JJ 198021

Continued

Table 1. *Continued.*

Taxa	Habit	Flowers	Field No.
Sphaeranthus indicus L.	H	November – December	JJ 199371
Tricholepis radicans (Roxb.) DC.	H	September – October	JJ 198051
Tridax procumbens L.	H	September – October	JJ 198020
Xanthium indicum Koen.	S	October – December	JJ 198163
Bignoniaceae			
Dolichandrone falcata (Wall. ex DC.) Seem.	T	August – September	JJ 198171
Boraginaceae			
Coldenia procumbens L.	H	July – August	JJ 199222
Cordia dichotoma Forst. f.	T	July – August	JJ 199248
Cordia sinensis Lam.	T	July – August	JJ 199287
Heliotropium bracteatum R. Br.	H	September – October	JJ 198070
Heliotropium indicum L.	H	Frequently throughout the year	JJ 199472
Heliotropium ovalifolium Forssk.	H	July – September	JJ 199232
Heliotropium supinum L.	H	October – December	JJ 199381
Trichodesma indicum (L.) Lehm.	H	August – September	JJ 198091
Trichodesma zeylanicum (Burm. f.) R. Br.	H	August – September	JJ 198188
Brassicaceae			
Brassica juncea (L.) Czern.	H	June – October	JJ 199476
Thlaspi arvensis L.	H	July – August	JJ 199298
Cactaceae			
Opuntia elatior Mill.	S	August – September	*
Caesalpiniaceae			
Bauhinia racemosa Lam.	T	June – August	JJ 198197
Caesalpinia bonduc (L.) Roxb.	S	July – December	JJ 199236
Chamaecrista mimosoides (L.) Greene	H	September – October	JJ 198049
Hardwickia binata Roxb.,	T	August – December	JJ 199246
Senna alata (L.) Roxb.	S	July – December	JJ 199475
Senna auriculata (L.) Roxb.	S	Almost throughout the year	JJ 198031
Senna italica Mill.	S	July – August	JJ 199281
Senna obtusifolia (L.) H.S. Irwin & Barneby	S	September – October	JJ 199402
Senna occidentalis (L.) Link	S	August – December	JJ 198113
Senna sophera (L.) Roxb.	S	July – August	JJ 199289
Senna tora (L.) Roxb.	S	July – August	JJ 199406
Senna uniflora (Mill.) H.S. Irwin & Barneby	S	September – December	JJ 198030
Capparaceae			
Capparis decidua (Forssk.) Edgew.	T	July – August	JJ 199201
Capparis divaricata Lam.	S	July – December	JJ 198196
Capparis grandis L.f.	T	April – August	JJ 199275
Cleome chelidonii L. f.	H	July – October	JJ 199221
Cleome gynandra L.	H	July – October	JJ 198263
Cleome simplicifolia (Cambess.) Hook. f. & Thoms.	H	July – September	JJ 198013
Cleome viscosa L.	H	July – September	JJ 198286
Caryophyllaceae			
Polycarpaea corymbosa (L.) Lam.	H	August – September	JJ 198012
Casuarinaceae			
Casuarina equisetifolia L.	T	August – October	JJ 199500
Colchicaceae			
Iphigenia indica (L.) Kunth	H	July – September	JJ 198147
Commelinaceae			
Commelina benghalensis L.	H	July – September	JJ 199489
Commelina diffusa Burm.f.	H	July – September	JJ 198059
Commelina erecta L.	H	July – September	JJ 199284
Commelina forskalaei Vahl	H	July – September	JJ 199488
Commelina caroliniana Walter	H	July – September	JJ 198252
Cyanotis axillaris (L.) D. Don ex Sweet	H	July – September	JJ 198237
Cyanotis cristata (L.) D.Don	H	July – September	JJ 198032
Cyanotis fasciculata (B. Heyne ex Roth) Schult. & Schult. f.	H	August – September	JJ 198008
Convolvulaceae			
Argyreia cymosa (Roxb.) Sweet	C	November – December	JJ 199344
Convolvulus arvensis L.	C	July – August	JJ 199292

Continued

Table 1. *Continued.*

Taxa	Habit	Flowers	Field No.
Evolvulus alsinoides (L.) L.	H	July – September	JJ 198016
Ipomoea aquatica Forssk.	H	July – September	JJ 199480
Ipomoea cairica (L.) Sweet	C	July – September	JJ 199365
Ipomoea carnea Jacq.	S	July – October	JJ 198279
Ipomoea eriocarpa R. Br.	C	November – December	JJ 199379
Ipomoea hederifolia L.	C	November – December	JJ 199309
Ipomoea nil (L.) Roth	C	August – September	JJ 198229
Ipomoea obscura (L.) Ker Gawl	C	September – December	JJ 198235
Ipomoea grandifolia (Dammer) O'Donell	C	September – December	JJ 198168
Ipomoea sindica Stapf	C	September – December	JJ 199466
Ipomoea violacea L.	C	September – December	JJ 199345
Merremia emarginata (Burm.f.) Hallier f.	H	September – December	JJ 198267
Rivea hypocrateriformis (Desr.) Choisy	C	July – December	JJ 198124
Cucurbitaceae			
Citrullus colocynthis (L.) Schrad.	C	July – October	JJ 199306
Citrullus lanatus (Thunb.) Matsum. & Nakai	C	July – October	JJ 199413
Coccinia grandis (L.) Voigt.	C	September - December	JJ 198187
Corallocarpus epigaeus (Rottler) Benth. & Hook. f.	C	September – October	JJ 198181
Cucumis prophetarum L.	C	September – December	JJ 199299
Cucumis sativus L.	C	September – December	JJ 198180
Diplocyclos palmatus (L.) C. Jeffrey	C	September – December	JJ 198118
Momordica charantia L.	C	July – October	JJ 199213
Momordica cymbalaria Hook.f.	C	July – August	JJ 199261
Momordica dioica Roxb. ex Willd.	C	July – October	JJ 199245
Mukia maderaspatana (L.) M. Roem.	C	September – October	JJ 198024
Cuscutaceae			
Cuscuta reflexa Roxb.	C	December – January	JJ 199274
Cyperaceae			
Bulbostylis barbata (Rottb.) C.B. Clarke	H	September – October	JJ 198042
Cyperus alulatus J. Kern	H	July – December	JJ 198066
Cyperus compressus L.	H	July – December	JJ 198283
Cyperus difformis L.	H	July – December	JJ 198206
Cyperus digitatus Roxb.	H	July – December	JJ 198215
Cyperus distans L. f.	H	August – October	JJ 198217
Cyperus exaltatus Retz.	H	August – December	JJ 199396
Cyperus iria L.	H	July – December	JJ 198036
Cyperus nutans var. *eleusinoides* (Kunth) R.W. Haines	H	July – December	JJ 198248
Cyperus pilosus Vahl	H	July – September	JJ 198096
Cyperus rotundus L.	H	July – December	JJ 198214
Cyperus tenuispica Steud.	H	August – October	JJ 198097
Eleocharis atropurpurea (Retz.) J. Presl. & C. Presl.	H	November – December	JJ 199319
Eleocharis geniculata (L.) Roem. & Schult.	H	August – December	JJ 198101
Fimbristylis complanata (Retz.) Link	H	July – October	JJ 198093
Fimbristylis dichotoma (L.) Vahl	H	July – December	JJ 198292
Fimbristylis ferruginea (L.) Vahl	H	August – October	JJ 198219
Fimbristylis ovata (Burm. f.) J. Kern	H	August – October	JJ 198294
Fimbristylis quinquangularis (Vahl) Kunth	H	September – October	JJ 198089
Fimbristylis tenera Schult.	H	September – October	JJ 198041
Fuirena cuspidata (Roth) Kunth	H	August – October	JJ 198246
Kyllinga brevifolia Rottb.	H	August – September	JJ 198035
Lipocarpha squarrosa (L.) Goetgheb.	H	August – September	JJ 198203
Mariscus squarrosus (L.) C.B. Clarke	H	August – September	JJ 198037
Pycreus flavidus (Retz.) T. Koyama	H	August – September	JJ 198218
Pycreus polystachyos (Rottb.) P. Beauv.	H	August – September	JJ 199493
Schoenoplectiella lateriflora (J.F. Gmel) Lye	H	July – September	JJ 199395
Schoenoplectiella roylei (Nees) Lye	H	September – October	*
Schoenoplectiella supina (L.) Lye	H	July – September	JJ 199397
Scleria parvula Steud.	H	July – September	JJ 198284
Eriocaulaceae			
Eriocaulon quinquangulare L.	H	August – September	JJ 198202

Continued

Table 1. *Continued.*

Taxa	Habit	Flowers	Field No.
Euphorbiaceae			
Acalypha indica L.	H	August – September	JJ 198149
Chrozophora rottleri (Geiseler) A. Juss.ex Spreng.	H	August – September	JJ 199427
Croton bonplandianus Baill.	H	August – October	JJ 198264
Euphorbia antiquorum L.	S	July – September	*
Euphorbia cristata B. Heyne ex Roth	H	July – September	JJ 198161
Euphorbia heterophylla L.	H	August – September	JJ 198157
Euphorbia heyneana Spreng.	H	November – December	JJ 199384
Euphorbia hirta L.	H	August – September	JJ 198011
Euphorbia hypericifolia L.	H	July – August	JJ 198010
Euphorbia indica Lam.	H	August – September	JJ 198274
Euphorbia notoptera Boiss.	H	August – September	JJ 198071
Euphorbia prostrata Aiton	H	August – September	JJ 199229
Euphorbia thymifolia L.	H	August – September	JJ 198275
Euphorbia tirucalli L.	S	December – February	JJ 199414
Flueggea leucopyrus Willd.	S	July – December	JJ 198067
Jatropha curcas L.	S	December – February	JJ 199249
Jatropha gossypiifolia L.	S	July – October	JJ 199207
Phyllanthus amarus Schumach. & Thonn.	H	July – October	JJ 198128
Phyllanthus debilis Klein ex Willd.,	H	August – December	JJ 199429
Phyllanthus maderaspatensis L.	H	August – December	JJ 198005
Phyllanthus reticulatus Poir.	S	July – October	JJ 198200
Phyllanthus simplex Retz.	H	July – October	JJ 199216
Ricinus communis L.	S	October – December	JJ 194803
Tragia plukenetii Radcl.-Sm.	H	August – October	JJ 198154
Fabaceae			
Abrus precatorius L.	C	Almost throughout the year	JJ 199390
Aeschynomene indica L.	S	September – October	JJ 198231
Alysicarpus glumaceus (Vahl) DC.	H	September – October	JJ 198173
Alysicarpus heyneanus Wight & Arn.	H	July – September	JJ 199322
Alysicarpus monilifer (L.) DC.	H	July – September	JJ 199451
Alysicarpus scariosus (Rottl. ex Spreng.) Graham ex Thwaites	H	September – October	JJ 199394
Alysicarpus tetragonolobus Edgew.	H	September – October	JJ 198085
Alysicarpus vaginalis (L.) DC. var. *nummularifolius* Miq.	H	September – October	JJ 198009
Butea monosperma (Lam.) Taub.	T	February – March	*
Canavalia africana Dunn	C	July – December	JJ 199343
Canavalia ensiformis (L.) DC.	C	July – December	JJ 199457
Crotalaria calycina Schrank	H	September – October	JJ 198153
Crotalaria filipes Benth	H	September – October	JJ 198256
Crotalaria hebecarpa (DC.) Rudd	H	September – December	JJ 198086
Crotalaria juncea L.	H	November – December	JJ 199399
Crotalaria orixensis Willd.	H	September – October	JJ 198162
Crotalaria pallida Aiton.	H	July – October	JJ 199473
Crotalaria vestita Baker	H	September – October	JJ 198122
Desmodium dichotomum (Willd.) DC.	H	September – October	JJ 198174
Desmodium gangeticum (L.) DC.	S	September – October	JJ 199447
Desmodium heterocarpon (L.) DC.	S	September – October	JJ 198129
Desmodium triflorum (L.) DC.	H	July – September	JJ 199497
Erythrina variegata L.	T	March – April	JJ 194804
Indigofera coerulea Roxb.	S	July – August	JJ 199296
Indigofera cordifolia B. Heyne ex Roth	H	September – December	JJ 198018
Indigofera linifolia (L.f.) Retz.	H	September – December	JJ 198025
Indigofera prostrata Willd.	H	August – October	*
Indigofera tinctoria L.	S	July – October	JJ 199291
Indigofera trifoliata L.	H	September – December	JJ 198190
Lablab purpureus (L.) Sweet	C	July – September	JJ 199356
Rhynchosia capitata (B. Heyne ex Roth) DC.	C	September – December	JJ 198198
Rhynchosia minima (L.) DC.	C	September – December	JJ 198120
Stylosanthes fruticosa (Retz.) Alston	S	September – October	JJ 198092
Stylosanthes viscosa (L.) Sw.	S	September – October	JJ 198258

Continued

Table 1. *Continued.*

Taxa	Habit	Flowers	Field No.
Tephrosia purpurea (L.) Pers.	S	September – October	JJ 198022
Tephrosia senticosa (L.) Pers.	S	September – December	JJ 198192
Tephrosia villosa (L.) Pers.	S	July – October	JJ 198226
Vigna aconitifolia (Jacq.) Morechal	C	August – September	JJ 198167
Vigna indica T.M. Dixit, K.V. Bhat & S.R. Yadav	C	August – September	JJ 198019
Vigna trilobata (L.) Verdc.	C	August – September	JJ 198164
Zornia gibbosa Span.	H	August – September	JJ 198001
Gentianaceae			
Canscora diffusa (Vahl) R. Br.	H	August – September	JJ 198220
Enicostema axillare (Lam.) Raynal	H	August – September	JJ 198073
Exacum pumilum Griseb.	H	August – September	JJ 198106
Geraniaceae			
Monsonia senegalensis Guill. & Perr.	H	July – August	JJ 199293
Hydrocharitaceae			
Ottelia alismoides (L.) Pers.	H	October – December	JJ 199354
Lamiaceae			
Hyptis suaveolens (L.) Poit.	H	July – September	JJ 198210
Lavandula bipinnata (Roth) Kuntze	H	August – September	JJ 198105
Leonotis nepetifolia (L.) R. Br.	S	November – December	JJ 199358
Leucas aspera (Willd.) Link	H	July – October	JJ 198244
Leucas lavandulifolia Sm.	H	July – October	JJ 198175
Leucas longifolia Benth.	H	July – October	JJ 198057
Ocimum tenuiflorum L.	H	July – October	JJ 198100
Orthosiphon pallidus Royle ex Benth.	H	July – September	JJ 198151
Lentibulariaceae			
Utricularia bifida L.	H	November – December	JJ 199375
Liliaceae			
Aloe vera (L.) Burm.f.	H	December – March	JJ 199492
Asparagus racemosus Willd.	C	October – February	JJ 199286
Chlorophytum laxum R. Br.	H	July – September	JJ 199285
Chlorophytum tuberosum (Roxb.) Baker	H	July – September	JJ 199252
Ledebouria hyacinthina (L.f.) Jessop	H	July – September	JJ 199217
Lobeliaceae			
Lobelia alsinoides Lam.	H	August – October	JJ 199376
Lythraceae			
Ammannia baccifera L.	H	November – December	JJ 198241
Ammannia multiflora Roxb.	H	September – October	JJ 198076
Malvaceae			
Abutilon hirtum (Lam.) Sweet	S	July – October	JJ 199270
Abutilon indicum (L.) Sweet	S	August – December	JJ 198230
Abutilon pannosum (G. Forst.) Schltdl.	S	September – December	JJ 198183
Hibiscus caesius Garcke	H	October – December	JJ 199359
Hibiscus lobatus (Murray) Kuntze.	H	December – January	JJ 199280
Malachra capitata (L.) L.	S	December – January	JJ 199462
Malvastrum coromandelianum (L.) Garcke	S	July – September	JJ 198160
Sida acuta Burm. f.	S	September – December	JJ 198261
Sida rhombifolia L.	S	October – December	JJ 194805
Sida spinosa L.	S	September – December	JJ 198289
Thespesia populnea (L.) Sol. ex Correa	T	August – December	JJ 194806
Martyniaceae			
Martynia annua L.	H	August – September	JJ 198115
Menispermaceae			
Cocculus hirsutus (L.) W. Theob.	C	Frequently throughout the year	JJ 198199
Tinospora cordifolia (Willd.) Miers ex Hook. f. & Thoms	C	July – October	JJ 198201
Mimosaceae			
Acacia campbelii Arn.	T	August – December	JJ 199329
Acacia catechu (L.f.) Willd.	T	August – October	JJ 198194
Acacia eburnea (L.f.) Willd.	T	September – December	JJ 194807
Acacia leucophloea (Roxb.) Willd.	T	September – December	JJ 198058
Acacia nilotica subsp. *cupressiformis* (J.L. Stewart) Ali & Faruqui	T	August – December	JJ 194808

Continued

Table 1. *Continued.*

Taxa	Habit	Flowers	Field No.
Acacia nilotica subsp. *indica* (Benth.) Brenan	T	September – October	JJ 198140
Acacia tomentosa Willd.	T	September – December	JJ 199273
Dichrostachys cinerea var. *indica* Brenan & Brummit	S	August – December	JJ 199237
Leucaena leucocephala (Lam.) de Wit	T	August – December	JJ 194809
Mimosa hamata Willd.	S	August – December	JJ 198099
Mimosa pudica L.	H	August – December	JJ 194810
Pithecellobium dulce (Roxb.) Benth.	T	February – June	JJ 199455
Prosopis juliflora (Sw.) DC.	T	February – June	JJ 194811
Molluginaceae			
Glinus lotoides L.	H	August – September	JJ 199240
Mollugo nudicaulis Lam.	H	September – October	JJ 198028
Mollugo stricta L.	H	September – December	JJ 199393
Moraceae			
Ficus benghalensis L.	T	February – June	JJ 194812
Ficus hispida L. f.	T	July – August	JJ 194813
Ficus microcarpa L. f.	T	July – August	JJ 199272
Ficus racemosa L.	T	July – August	JJ 199250
Ficus religiosa L.	T	July – August	JJ 194814
Nyctaginaceae			
Boerhavia erecta L.	H	September – October	JJ 199421
Boerhavia diffusa L.	H	September – October	JJ 198077
Mirabilis jalapa L.	H	Frequently throughout the year	JJ 199486
Onagraceae			
Ludwigia hyssopifolia (G.Don) Exell	H	September – October	JJ 198211
Oxalidaceae			
Biophytum sensitivum (L.) DC.	H	September – October	JJ 198033
Oxalis corniculata L.	H	Almost throughout the year	JJ 199366
Papaveraceae			
Argemone mexicana L.	H	Almost throughout the year	JJ 198300
Passifloraceae			
Passiflora foetida L.	C	August – December	JJ 194815
Pedaliaceae			
Sesamum laciniatum Klein. ex Willd.	H	August – September	JJ 198023
Sesamum indicum L.	H	August – September	JJ 198146
Periplocaceae			
Cryptolepis buchananii Roem. & Schult.	S	July – September	JJ 198233
Cryptostegia grandiflora R. Br.	S	July – September	JJ 198056
Hemidesmus indicus (L.) Schult.	C	July – September	JJ 199479
Plumbaginaceae			
Plumbago zeylanica L.	S	September – October	JJ 198232
Poaceae			
Alloteropsis cimicina (L.) Stapf.	H	July – September	JJ 198127
Andropogon pumilus Roxb.	H	July – December	JJ 198133
Apluda mutica L.	H	September – December	JJ 198170
Aristida adscensionis L.	H	September – December	JJ 199348
Aristida funiculata Trin. & Rupr.	H	September – December	JJ 199494
Aristida hystrix L. f.	H	September – December	JJ 198139
Aristida redacta Stapf.	H	September – December	JJ 198108
Aristida setacea Retz.	H	September – December	JJ 199495
Aristida stocksii (Hook. f.) Domin	H	July – December	JJ 198040
Arundinella tuberculata Munro ex Lisboa	H	September – November	*
Arundo donax L.	H	September – November	JJ 199334
Bothriochloa pertusa (L.) A. Camus	H	September – December	JJ 198029
Brachiaria distachya (L.) Stapf.	H	September – November	JJ 198117
Brachiaria eruciformis (Sm.) Griseb.	H	July – September	JJ 198165
Brachiaria ramosa (L.) Stapf.	H	July – September	JJ 198176
Cenchrus setigerus Vahl	H	July – September	JJ 198184
Chionachne gigantea (J. Koenig) Veldkamp	H	July – September	JJ 198259
Chloris gayana Kunth ex Stapf	H	July – September	JJ 198135
Chrysopogon fulvus (Spreng.) Chiov.	H	August – September	JJ 198143

Continued

Table 1. *Continued.*

Taxa	Habit	Flowers	Field No.
Coix lacryma-jobi L.	H	July – September	JJ 199368
Cymbopogon martini (Roxb.) S. Watson	H	July – October	JJ 198265
Cynodon dactylon (L.) Pers.	H	August – October	JJ 199224
Dactyloctenium aegyptiacum (L.) Willd.	H	August – October	JJ 198260
Dactyloctenium aristatum Link	H	August – October	JJ 198048
Dichanthium foveolatum (Delile) Roberty	H	August – October	JJ 198185
Digitaria ciliaris (Retz.) Koeler	H	August – October	JJ 198044
Digitaria stricta Roth ex Roem. & Schult.	H	August – October	JJ 198081
Digitaria ternata (A. Rich.) Stapf.	H	September – December	JJ 199496
Dinebra retroflexa (Vahl) Panz.	H	August – October	JJ 198269
Echinochloa colonum (L.) Link	H	August – September	JJ 198046
Eleusine indica (L.) Gaertn.	H	July – September	JJ 198227
Eragrostiella bifaria (Vahl)	H	July – September	JJ 198111
Eragrostiella brachyphylla (Stapf) Bor	H	July – September	JJ 198043
Eragrostis gangetica (Roxb.) Steud	H	September – October	JJ 198112
Eragrostis pilosa (L.) P. Beauv.	H	September – October	JJ 198045
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	H	August – October	JJ 198268
Eragrostis unioloides (Retz.) Nees ex Steud.	H	August – October	JJ 199382
Eragrostis viscosa (Retz.) Trin.	H	September – October	JJ 199336
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	H	September – October	JJ 198079
Heteropogon triticeus (R. Br.) Stapf ex Craib	H	September – October	JJ 199370
Isachne borii Hemadri	H	September – October	*
Ischaemum afrum (J.F. Gmel.) Dandy	H	July – September	JJ 198186
Iseilema anthephoroides Hack.	H	September – October	JJ 198026
Hackelochloa granularis (L.) Kuntze	H	September – October	JJ 198014
Lophopogon tridentatus (Roxb.) Hack.	H	August – October	JJ 198038
Melanocenchris jacquemontii Jaub. & Spach	H	August – October	JJ 198039
Oropetium roxburghianum (Steud.) S.M. Phillips	H	August – September	JJ 199226
Oropetium thomaeum (L. f.) Trin.	H	August – September	JJ 198126
Oropetium villosulum Stapf ex Bor	H	August – September	JJ 199419
Oryza sativa L.	H	July– September	JJ 198285
Panicum hippothrix K.Schum. ex Engl.	H	July – October	JJ 199498
Panicum curviflorum Hornem	H	September – October	JJ 198087
Paspalidium flavidum (Retz.) A. Camus	H	August – October	JJ 198027
Pennisetum pedicellatum Trin.	H	July – September	JJ 199499
Pennisetum purpureum Schumach.	H	July – September	JJ 199271
Sehima ischaemoides Forssk.	H	July – October	JJ 198137
Sehima sulcatum (Hack.) A. Camus	H	July – October	JJ 199392
Setaria intermedia Roem. & Schult.	H	July – September	JJ 198136
Setaria pumila (Poir.) Roem. & Schult.	H	July – October	JJ 198047
Spodiopogon rhizophorus (Steud.) Pilg.	H	July – October	*
Sporobolus coromandelianus (Retz.) Kunth	H	July – October	*
Sporobolus indicus (L.) R. Br.	H	July – October	JJ 199452
Tetrapogon tenellus (J. Koenig ex Roxb.) Chiov.	H	July – October	JJ 198225
Themeda laxa (Andersson) A. Camus	H	July – December	JJ 199369
Tragus mongolorum Ohwi	H	July – October	JJ 198074
Tripogon bromoides Roth	H	July – October	JJ 199437
Tripogon jacquemontii Stapf	H	July – October	JJ 198249
Polygalaceae			
Polygala arvensis Willd.	H	July – September	JJ 198034
Polygala erioptera DC. Prodr.	H	August – September	JJ 198084
Polygonaceae			
Antigonon leptopus Hook. & Arn.	C	Almost throughout the year	JJ 199487
Persicaria glabra (Willd.) M. Gomez	H	August – September	JJ 199453
Polygonum plebeium R. Br.	H	July – September	JJ 199227
Pontederiaceae			
Eichhornia crassipes (Mart.) Solms	H	Almost throughout the year	*
Portulacaceae			
Portulaca oleracea L.	H	July – September	JJ 198017
Portulaca tuberosa Roxb.	H	July – September	JJ 198204
Portulaca quadrifida L.	H	August – September	JJ 199430

Continued

Table 1. *Continued.*

Taxa	Habit	Flowers	Field No.
Rhamnaceae			
Ziziphus mauritiana Lam.	S	September – December	JJ 198068
Ziziphus xylopyrus (Retz.) Willd.	S	August – December	JJ 199386
Rubiaceae			
Benkara malabarica (Lam.) Tirveng.	S	June – October	JJ 198223
Dentella repens (L.) J.R. Forst. & G. Forst.	H	July – August	JJ 199225
Kohautia aspera (B. Heyne ex Roth) Bremek.	H	August – November	*
Morinda pubescens J.E. Sm.	T	Almost throughour the year	JJ 198055
Neanotis montholonii (Hook. f.) W.H. Lewis	H	September – October	JJ 198159
Oldenlandia corymbosa L.	H	September – October	JJ 198240
Oldenlandia diffusa (Willd.) Roxb.	H	September – October	JJ 199468
Oldenlandia umbellata L.	H	August – December	*
Spermacoce articularis L.f.	H	September – October	JJ 198064
Spermacoce pusilla Wall.	H	September – October	JJ 198003
Santalaceae			
Santalum album L.	T	August – October	JJ 198114
Sapindaceae			
Cardiospermum halicacabum L.	C	Almost throughout the year	JJ 198130
Scrophulariaceae			
Bacopa monnieri (L.) Wettst.	H	July – August	JJ 199290
Limnophila heterophylla (Roxb.) Benth.	H	November – December	JJ 199374
Lindernia antipoda (L.) Alston	H	November – December	JJ 199483
Lindernia ciliata (Colsm.) Pennell	H	November – December	JJ 199378
Lindernia crustacea (L.) F. Muell.	H	November – December	JJ 199484
Sopubia delphinifolia D. Don	H	August – September	JJ 198061
Stemodia viscosa Roxb.	H	November – December	JJ 199373
Striga asiatica (L.) Kuntze	H	August – September	JJ 198006
Striga densiflora (Benth.) Benth	H	August – September	JJ 198004
Striga gesnerioides (Willd.) Vatke	H	August – September	JJ 198069
Verbascum chinense (L.) Santapau	H	July – August	JJ 199230
Solanaceae			
Datura inoxia Mill.	H	September – December	JJ 198278
Datura metel L.	H	September – December	JJ 199481
Datura ferox L.	H	August – September	JJ 199409
Physalis angulata L.	H	July – August	JJ 198182
Solanum erianthum D. Don	S	July – August	JJ 199247
Solanum incanum L.	S	July – September	JJ 199211
Solanum americanum Mill.	S	July – October	JJ 199482
Solanum virginianum L.	S	July – October	JJ 199214
Tiliaceae			
Corchorus fascicularis Lam.	H	September – December	JJ 198065
Corchorus olitorius L.	H	September – December	JJ 198121
Corchorus trilocularis L.	H	September – December	JJ 198243
Grewia tenax (Forssk.) Fiori	S	April – September	*
Grewia villosa Willd.	S	August – December	JJ 199326
Triumfetta malabarica Koen. ex Rottb.	S	September – October	JJ 198155
Typhaceae			
Typha angustifolia L.	H	July – September	JJ 199367
Verbenaceae			
Clerodendrum phlomidis L. f.	S	July – December	JJ 199253
Lantana camara L.	S	Frequently throughout the year	JJ 199485
Phyla nodiflora (L.) Greene	H	July – August	JJ 199219
Vitex negundo L.	S	July – September	JJ 199206
Vitaceae			
Cissus arnottiana Shetty & P. Singh	S	Irregularly throughout the year	JJ 198224
Cissus quadrangularis L.	C	Almost throughout the year	JJ 194816
Zygophyllaceae			
Balanites aegyptiaca (L.) Delile	S	July – December	JJ 198266
Tribulus terrestris L.	H	July – December	JJ 198007

coupled with high probability of extinction of bustards in the near future, the Ministry of Environment and Forests (MoEF), Government of India, has included the Great Indian Bustard under the Species recovery component of the Centrally Sponsored Scheme – Integrated Development of Wildlife Habitats (CSS-IDWH). In this programme, a task force is constituted to prepare an action plan to conserve bustards and their habitats. Hence, this documentation study is important in providing the floristic diversity of the bustard habitat, to continue habitat specific conservation measures.

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Figure 6. View of different habitats in Great Indian Bustard Wildlife sanctuary. **A:** View of core area at Nannaj. **B:** Clumps of grass dominated by *Cymbopogon* spp. **C:** Population of *Cyanotis fasciculata* amidst grasses. **D:** Seasonal lake inside the sanctuary showing scrub vegetation. **E:** View of rocky plateau inside the sanctuary. **F:** Herd of Black-buck population during monsoon season.

Figure 7. Different views of the sanctuary during dry season. **A:** View of grassland at Mardi. **B:** View at Karmala. **C:** View at Chapadgoan. **D:** View at Nannaj. **E:** View at Korti. **F:** View at Rehkuri.

Figure 8. Legumes of the sanctuary. **A:** *Crotalaria calycina*. **B:** *C. filipes*. **C:** *C. hebecarpa*. **D:** *C. juncea*. **E:** *C. pallida*. **F:** *Desmodium heterocarpon*. **G:** *D. triflorum*. **H:** *Indigofera coerulea*. **I:** *I. cordifolia*. **J:** *I. linifolia*. **K:** *I. tinctoria*. **L:** *I. trifoliata*.

Figure 9. *Senna* and *Acacia* species found in the sanctuary. **A:** *Senna italica*. **B:** *S. occidentalis*. **C:** *S. sophera*. **D:** *S. uniflora*. **E:** *Acacia campbelii*. **F:** *A. catechu*. **G:** *A. eburnea*. **H:** *A. leucophloea*. **I:** *A. nilotica*. **J:** *A. tomentosa*.

Figure 10. "Morning glories" recorded from the sanctuary. **A:** *Convolvulus arvensis.* **B:** *Evolvulus alsinoides.* **C:** *Ipomoea cairica.* **D:** *I. carnea.* **E:** *I. eriocarpa.* **F:** *I. grandifolia.* **G:** *I. hederifolia.* **H:** *I. nil.* **I:** *I. obscura.* **J:** *I. sindica*- in flower. **K:** *I. sindica* – in fruit. **L:** *I. violacea.*

Figure 11. Sedges of the sanctuary. **A:** *Cyperus compressus*. **B:** *C. difformis*. **C:** *C. digitatus*. **D:** *C. iria*. **E:** *C. nutans var. eleusinoides*. **F:** *C. rotundus*. **G:** *Eleocharis geniculata*. **H:** *Fimbristylis ferruginea*. **I:** *Fuirena cuspidata*. **J:** *Kyllinga brevifolia*. **K:** *Lipocarpha squarrosa*. **L:** *Mariscus squarrosus*.

Figure 12. Grasses of the sanctuary. **A:** *Apluda mutica*. **B:** *Hackelochloa granularis*. **C:** *Lophopogon tridentatus*. **D:** *Melanocenchris jacquemontii*. **E:** *Oropetium roxburghianum*. **F:** *Sehima ischaemoides*.**G:** *Themeda laxa*. **H:** *Tragus mongolorum*. **I:** *Pennisetum purpureum*